CLAIMS

1. An organic semiconductor structure having, in at least a part thereof, an organic semiconductor layer comprising an aligned liquid crystalline organic semiconductor material,

said liquid crystalline organic semiconductor material comprising an organic compound having a core comprising L 6 π electron rings, M 8 π electron rings, N 10 π electron rings, O 12 π electron rings, P 14 π electron rings, Q 16 π electron rings, R 18 π electron rings, S 20 π electron rings, T 22 π electron rings, U 24 π electron rings, and V 26 π electron rings, wherein L, M, N, O, P, Q, R, S, T, U, and V are each an integer of 0 (zero) to 6 and L + M + N + O + P + Q + R + S + T + U + V = 1 to 6, said liquid crystalline organic semiconductor material exhibiting at least one liquid crystal state at a temperature below the heat decomposition temperature thereof.

2. An organic semiconductor structure having, in at least a part thereof, an organic semiconductor layer comprising an aligned liquid crystalline organic semiconductor material,

said liquid crystalline organic semiconductor material comprising an organic compound having a core comprising L 6 π electron rings, M 8 π electron rings, N 10 π electron rings, O 12 π electron rings, P 14 π electron rings, Q 16 π electron rings, R 18 π electron rings, S 20 π electron rings, T 22 π electron rings, U 24 π electron rings, and V 26 π electron rings, wherein L, M, N, O, P, Q, R, S, T, U, and V are each an integer of 0 (zero) to 6 and L + M + N + O + P + Q + R + S + T + U + V = 1 to 6, said liquid crystalline organic semiconductor material exhibiting at least a smectic liquid crystal phase state at a temperature below the heat decomposition temperature thereof.

3. An organic semiconductor structure having, in at least a part thereof, an organic semiconductor layer comprising an aligned liquid crystalline organic semiconductor material,

said liquid crystalline organic semiconductor material

comprising an organic compound having a core comprising L 6 π electron rings, M 8 π electron rings, N 10 π electron rings, O 12 π electron rings, P 14 π electron rings, Q 16 π electron rings, R 18 π electron rings, S 20 π electron rings, T 22 π electron rings, U 24 π electron rings, and V 26 π electron rings, wherein L, M, N, O, P, Q, R, S, T, U, and V are each an integer of 0 (zero) to 6 and L + M + N + O + P + Q + R + S + T + U + V = 1 to 6, said liquid crystalline organic semiconductor material having, at its both ends, a terminal group capable of developing liquid crystallinity.

4. The organic semiconductor structure according to any one of claims 1 to 3, wherein at least a part of said liquid crystalline organic semiconductor material in the organic semiconductor layer has been aligned and crystallized by holding the liquid crystalline organic semiconductor material at a temperature suitable for the conversion of the liquid crystalline organic semiconductor material to a liquid crystal state, and then cooling the liquid crystalline organic semiconductor material.

5. The organic semiconductor structure according to any one of claims 1 to 4, wherein said organic semiconductor layer is provided in contact with a liquid crystal aligning layer and the provision of the organic semiconductor layer in contact with the liquid crystal aligning layer allows the liquid crystalline organic semiconductor material to be anisotropically aligned in a specific direction.

6. The organic semiconductor structure according to claim 5, wherein said liquid crystal aligning layer is formed of a polyimide material.

7. The organic semiconductor structure according to claim 5, wherein said liquid crystal aligning layer is formed of a cured resin having fine concaves and convexes on its surface.

8. The organic semiconductor structure according to claim 5, wherein said liquid crystal aligning layer comprises a cured resin which has fine concaves and convexes on its surface and functions also as a substrate.

9. A process for producing the organic semiconductor structure according to any one of claims 1 to 3, comprising the steps of: allowing said liquid crystalline organic semiconductor material to experience or be held at the liquid crystal development temperature of the liquid crystalline organic semiconductor material to once convert the liquid crystalline organic semiconductor material to a liquid crystal state; and cooling the liquid crystalline organic semiconductor material in a liquid crystal state to align and crystallize the liquid crystalline organic semiconductor material.

10. An organic semiconductor device comprising a substrate, a gate electrode, a gate insulating layer, an organic semiconductor layer, a drain electrode, and a source electrode,

said organic semiconductor layer comprising a liquid crystalline organic semiconductor material having a core comprising L 6 π electron rings, M 8 π electron rings, N 10 π electron rings, O 12 π electron rings, P 14 π electron rings, Q 16 π electron rings, R 18 π electron rings, S 20 π electron rings, T 22 π electron rings, U 24 π electron rings, and V 26 π electron rings, wherein L, M, N, O, P, Q, R, S, T, U, and V are each an integer of 0 (zero) to 6 and L + M + N + O + P + Q + R + S + T + U + V = 1 to 6.

11. The organic semiconductor device according to claim 10, wherein organic liquid crystalline molecules constituting said liquid crystalline organic semiconductor material are aligned in a direction orthogonal to the film thickness direction of a drain electrode and a source electrode provided on the gate insulating layer, and so as to be transversely arranged between the drain

electrode and the source electrode.

12. The organic semiconductor device according to claim 10, wherein organic liquid crystalline molecules constituting said liquid crystalline organic semiconductor material are aligned in parallel with the film thickness direction of a drain electrode and a source electrode provided on the gate insulating layer.

13. The organic semiconductor device according to any one of claims 10 to 12, wherein said liquid crystalline organic semiconductor material has smectic liquid crystallinity at a predetermined temperature below the heat decomposition temperature of said liquid crystalline organic semiconductor material and has a charge mobility of not less than 10^{-5} $cm^2/V \cdot s$ or a hole transport mobility of not less than 10^{-5} $cm^2/V \cdot s$.

14. An organic semiconductor structure comprising an organic semiconductor layer and a liquid crystal aligning layer, said organic semiconductor layer comprising a liquid crystalline organic semiconductor material, which exhibits at least one liquid crystal state at a predetermined temperature below the heat decomposition temperature thereof, and being provided in contact with the liquid crystal aligning layer, at least a part of the liquid crystalline organic semiconductor material having been aligned and crystallized.

15. The organic semiconductor structure according to claim 14, wherein said liquid crystalline organic semiconductor material comprises an organic compound having a core comprising L 6 π electron rings, M 8 π electron rings, N 10 π electron rings, O 12 π electron rings, P 14 π electron rings, Q 16 π electron rings, R 18 π electron rings, S 20 π electron rings, T 22 π electron rings, U 24 π electron rings, and V 26 π electron rings, wherein L, M, N, O, P, Q, R, S, T, U, and V are each an integer of 0 (zero) to 6 and L + M + N + O + P + Q + R + S + T + U + V = 1 to 6.

16. The organic semiconductor structure according to claim 14 or 15, wherein at least a part of said liquid crystalline organic semiconductor material in the organic semiconductor layer has been aligned and crystallized by holding the liquid crystalline organic semiconductor material at a temperature suitable for the conversion of the liquid crystalline organic semiconductor material to a liquid crystal state and then cooling the liquid crystalline organic semiconductor material.

17. The organic semiconductor structure according to any one of claims 14 to 16, wherein said liquid crystal aligning layer is formed of a polyimide material.

18. The organic semiconductor structure according to any one of claims 14 to 16, wherein said liquid crystal aligning layer is formed of a cured resin having fine concaves and convexes on its surface.

19. The organic semiconductor structure according to any one of claims 14 to 16, wherein said liquid crystal aligning layer comprises a cured resin which has fine concaves and convexes on its surface and functions also as a substrate.

20. Use of the organic semiconductor structure according to any one of claims 14 to 19 as an organic transistor, an organic EL, an organic electronic device, or an organic solar cell.